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PROJECT SPECIFIC PLAN FOR PUMPING TEST, PILOT PLANT DRAINAGE DITCH PLUME AREA

PROJECT NUMBER 52424-PSP-0001

AUGUST 2000

Prepared by

Fluor Daniel Fernald

Prepared for

U.S. Department of Energy
Fernald Field Office

Under Contract DE-AC05-92OR21972

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1.0 INTRODUCTION

This work plan serves as the controlling document for installing a pumping test network of groundwater wells and conducting a multiple-well pumping test within the Pilot Plant Drainage Ditch Plume, hereinafter referred to as the "pumping test". Data collected from the pumping test will be used to refine hydraulic conductivity values within the site groundwater model in the area of the Pilot Plant Drainage Ditch Plume. The Pilot Plant Drainage Ditch Plume and the location of the pumping test are shown in Figure 1-1.

This test is needed to support engineering design of the Aquifer Remediation System for this area of the aquifer. Characterization to support the conceptual design for remediation of this area was conducted from November 8, 1999 to May 2, 2000 (DOE 2000). As a result of the characterization a portion of the Waste Storage Area uranium plume, in the vicinity of the confluence of Paddys Run and the Pilot Plant Drainage Ditch was redefined and extended to the east. This plume is identified as the Pilot Plant Drainage Ditch Plume, Figure 1-1.

The site groundwater model that is being used to support the engineering design of aquifer remediation systems has a hydraulic conductivity boundary running through the Pilot Plant Drainage Ditch Plume. Figure 1-1 shows the location of this modeled hydraulic conductivity boundary in relation to the plume. Hydraulic conductivity modeled north of the boundary is lower than hydraulic conductivity modeled south of the boundary. The location of this boundary within the model is based upon extrapolation of pumping test results from surrounding areas. Cleanup predictions modeled for the Pilot Plant Drainage Ditch Plume are strongly influenced by the location of this hydraulic conductivity boundary. Therefore, further refinement of hydraulic conductivity values in this area of the aquifer is needed to support engineering design for the Aquifer Remediation System.

The pumping test will provide the information needed to better determine hydraulic conductivity values for the Pilot Plant Drainage Ditch Plume area. One 12-inch diameter control well, and seven, 2-inch diameter observation wells will be installed to support the test. The testing program will consist of both a step test and a seven-day constant rate-pumping test. The step test will be conducted to determine the pumping rate that will be used for the seven-day constant rate test. While the control well is being pumped, drawdown data will be collected from the system of surrounding observation wells. The drawdown data will be used to calculate hydraulic conductivity and to assess aquifer anisotropy. New calculated values of hydraulic conductivity and information concerning anisotropy will be used to recalibrate this area of the Site Groundwater Model.

The rest of this PSP is organized as follows:

- Section 2 outlines responsibilities and identifies project personnel.
- Section 3 provides background for the testing program.
- Section 4 covers the design and installation of the control and observation wells.
- Section 5 outlines the pumping test activities.
- Section 6 discusses data management, analysis, and reporting.
- Section 7 outlines health and safety requirements.
- Section 8 outlines QA/QC requirements.
- Section 9 provides references cited in the PSP.

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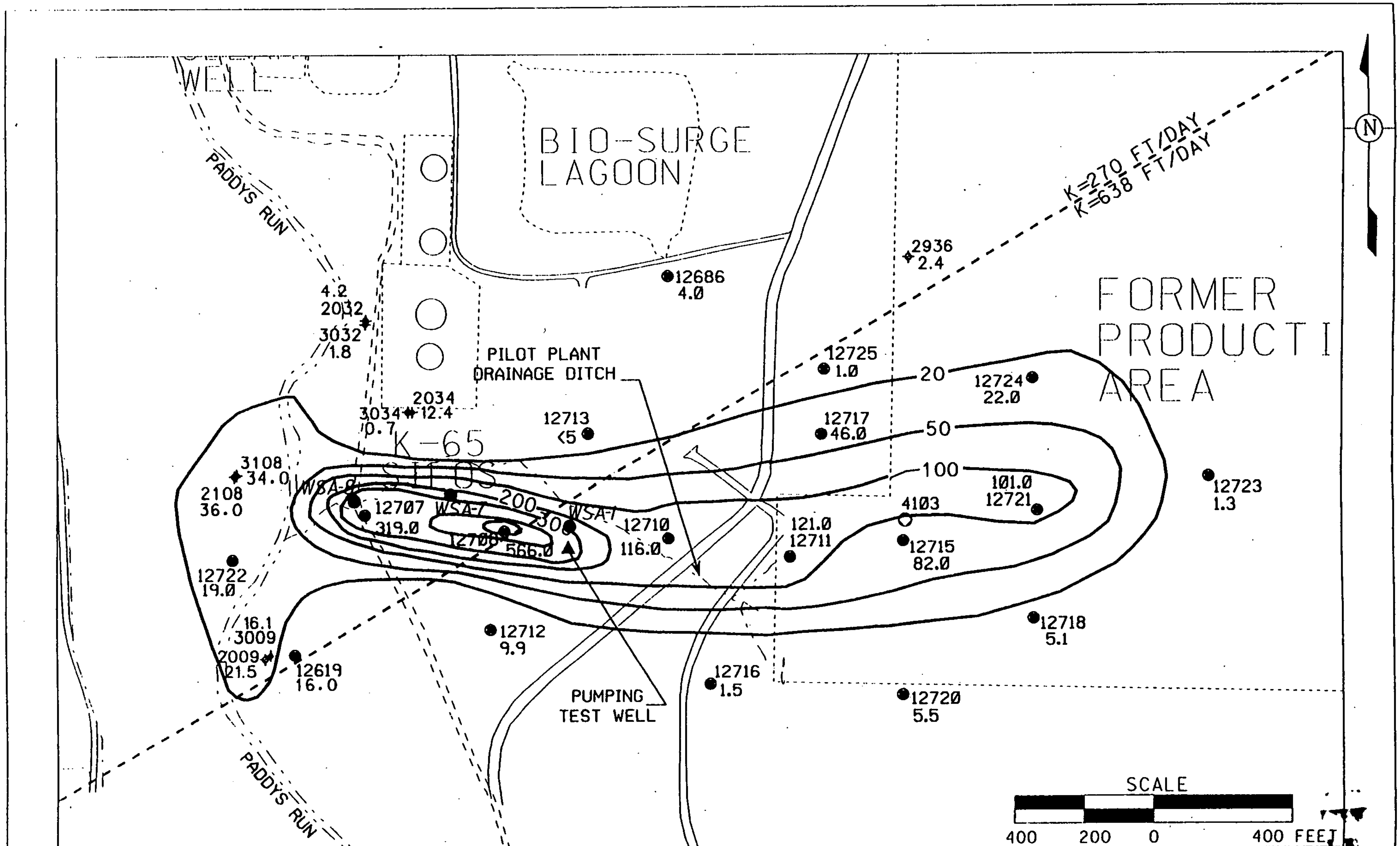

LEGEND:

- (solid line) PILOT PLANT DRAINAGE DITCH PLUME, TOTAL URANIUM CONTOUR, APRIL, 2000 ($\mu g/L$)
- (dashed line) MODELED HYDRAULIC CONDUCTIVITY BOUNDARY
- ▲ PROPOSED PTW LOCATION
- ✦ RECENT DATA (JANUARY AND FEBUARY 2000)
- ● COMPLETED GEOPROBE LOCATION
- ✦ ✦ IEMP DATA (DECEMBER 1999)

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FIGURE 1-1. PUMPING TEST LOCATION

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2.0 MANAGEMENT AND ORGANIZATION

A qualified subcontractor under the direct supervision of Fluor Fernald will conduct drilling activities. Fluor Fernald personnel will perform all sampling activities defined in this work plan. Descriptions of some of the key technical responsibilities of project personnel or organizations are provided below.

The DOE Operable Unit 5 Team Leader is responsible for:

- Providing direction and oversight to the completion of PSP activities.
- Acting as the point of contact within DOE and for the regulators and stakeholders for all communications concerning work carried out under this PSP.

The Fluor Fernald Aquifer Restoration/Wastewater Project (ARWWP) Director is responsible for:

- Providing overall project management and technical guidance to the FDF team.
- Ensuring the necessary resources are allocated to the project for the efficient and safe completion of PSP activities.
- Overseeing and auditing PSP activities to ensure that the work is being performed efficiently and in accordance with all regulatory requirements and commitments, DOE Orders, site policies and procedures, and safe working practices.

The ARWWP Project Lead is responsible for:

- The safe and prompt completion of work outlined in the PSP.
- Providing a project engineer to procure needed materials.
- Establishing and maintaining the scope, schedule, and cost baseline.
- Obtaining the necessary funding to complete the sampling and data analysis activities.

The ARWWP Hydrogeology Section Team Coach is responsible for:

- Providing a technical lead for the oversight and programmatic direction of the Pumping Test sampling activities and the interpretation of data.

- Reporting to the DOE Operable Unit 5 Team Leader and ARWWP Project Director on the status of PSP activities, and on the identification of any problems encountered in the accomplishment of the PSP.

- Oversight and programmatic direction of sampling activities.

The ARWWP Project Engineer

- Procuring of needed materials and funding for the project.

The ARWWP Technical Lead is responsible for:

- Reporting to the Fluor Hydrogeology Section Team Coach on the progress of PSP activities.

- Assisting field personnel as required to complete work prescribed in this PSP.

- Assuring that data needed for screen and well design is collected.

- Oversight and programmatic direction of the Pumping Test, sampling activities and the interpretation of the data.

- Designing the pumping test, selecting locations for the control and observation wells, and allocating responsibilities so that project objectives are met.

- Documenting the testing set-up including preparation of a diagram of equipment used in the pumping test (dimensions, depth of water intakes, locations of gauges, etc.).

- Completing a pumping test report that details testing activities and presents results.

- Determining the step test and constant rate pumping rates.

The drilling contractor is responsible for:

- The on-site operations of any drilling rigs.

- Well development, as directed by Fluor personnel.

The Fluor Fernald Environmental Monitoring Water Sampling Team Coach is responsible for:

- Providing a geologist to supervise the installation of the test well and observation wells.

- Managing the collection of sediment and water samples specified in this PSP.

- Managing the collection of drawdown data during the Pumping Test as directed by the ARWWP Technical Lead.

- Securing needed testing instrumentation, as directed by the ARWWP Technical Lead.

Geologist in charge is responsible for:

- Documenting the geology of each boring.

- Being present whenever a borehole is being advanced, casing and screen is being installed, and during well development activities.

- Generating subsurface logs for each boring, for complete and accurate generation of a daily log of project activities, and for preparing lithologic logs in the field.

- Documenting lithology and depositional features rotosonic cores.

- Handling and storage of rotosonic cores.

- Determining that all test equipment is in proper working order before the start of the test.

- Securing all field instrumentation and equipment after completion of the pumping test.

- On-site coordination of the pumping test, including instrumentation set up in the field and data collection.

PSP personnel contacts are listed below.

TABLE 2-1

KEY PROJECT PERSONNEL

Contact	Name	Phone
DOE Operable Unit 5 Team Leader	Rob Janke	648-3124
ARWWP Project Director	Dave Brettschneider	648-5814
ARWWP Project Lead	Jack Hughes	648-3751
ARWWP/Hydrogeology Section Team Coach	Bill Hertel	648-3894
ARWWP Project Engineer	Dick Butterfield	648-3765
ARWWP Technical Lead	Ken Broberg	648-5824
Drilling Contractor	Moody's of Dayton	648-5255
Environmental Monitoring Water Monitoring Team Coach	Karen Voisard	648-3251
Geologist in charge	Thea Layne	648-3255
Health and Safety	Keith Lanning	648-4333
Laboratory	Denise Arico	648-3668
Quality Assurance	Scott Wheeler	648-4949

3.0 BACKGROUND

The Pilot Plant Drainage Ditch Plume is located in the Great Miami Aquifer (GMA). The GMA is a textbook example of a glacio-fluvial buried valley aquifer. The Pump Test Well is located along the northwestern edge of the New Haven Trough slightly downgradient of the confluence of the Shandon Tributary (to the north) and the Dry Fork Section of the New Haven Trough (to the west). Figure 3-1 is a map that shows the location of the Pumping Test Well (PTW) in relation to the dimensions of the buried valley and the topography of the bedrock. The buried valley is bounded by Ordovician age shale and limestone bedrock along the floors and walls. At the location of the pumping test the depth to bedrock is approximately 180 feet below ground surface (bgs).

The New Haven Trough was carved into the shale bedrock during the Pleistocene and subsequently filled with sand and gravel in what was most probably a braided stream depositional environment. Glaciation during the Wisconsin time deposited a layer of clay rich glacial overburden over the sand and gravel outwash deposits. Drilling records prepared from drilling at Monitoring Wells 4008 and 4108 were used to document subsurface lithology for the testing area. These wells are shown in Figure 3-1.

At the pumping test location, approximately 15 feet of clay overlies the aquifer. The sand and gravel that comprises the matrix of the GMA is approximately 160 feet thick. The aquifer is divided into upper and lower units by a layer of clay. At the Pumping Test location the clay layer dividing the aquifer is approximately two to five feet thick. Figure 3-2 is a map showing the location and thickness of the clay layer. The upper sand and gravel aquifer at the pumping test location is approximately 88 feet thick, but only approximately 47 feet to 58 feet of the upper aquifer is saturated. Seasonal water table fluctuations recorded for the area are up to eleven feet. These were recorded from water level data collected in Monitoring Wells 2108, 2009, 2042, and 2020. Hydrographs for these wells are provided in Appendix A. The sand and gravel beneath the clay layer at the pumping test location is approximately 70 feet to 73 feet thick.

An intermittently flowing stream (Paddy's Run) is located approximately 800 feet west of the Pumping Test Well. The Pilot Plant Drainage Ditch is located approximately 125 feet northeast of the Pumping Test Well. Sections of both of these surface features are in direct physical contact with the sand and gravel of the GMA and represent recharge zones to the aquifer. Monitoring of precipitation and GMA water levels near confluence of these two features will be conducted to support the pumping test.

Since 1943, 12 pumping tests have been conducted near the FEMP for the purpose of determining horizontal hydraulic conductivity (K_h) within the GMA. Table 3-1 shows values of K_h calculated from these 12 tests. The K_h ranges from a minimum of 120 feet/day to a maximum of 774 feet/day. The current site groundwater model is zoned for hydraulic conductivity as depicted in Figure 3-3. The hydraulic conductivity boundary that separates Zone V from Zone IV is also the boundary depicted in Figure 1-1. Although these boundaries are depicted as lines, in reality hydraulic conductivity transitions take place over a wider distance.

Results from the South Field Pumping Test confirmed that the hydraulic conductivity in the South Field in the area of Extraction Well 31550 is approximately 524 feet/day (DOE, 1995). At the time that the South Field Pumping Test data became available, the model was already calibrated as shown in Figure 3-3. The modeled value of hydraulic conductivity for model layers 1 and 2 in zone IV was 588.5 feet/day. This modeled value for hydraulic conductivity was judged as being close enough to the calculated value of hydraulic conductivity from the South Field Pumping Test of 524 feet/day to not warrant re-calibration of the groundwater model. Results of a pump test conducted in 1962 in Production Well 4101 (267 feet/day) in the lower portion of the Great Miami Aquifer (beneath the clay layer) was used to calibrate the model in Zone V. (Speiker & Norris, 1962). It is anticipated that the hydraulic conductivity that will result from the upcoming pumping test will be a value between 267 feet/day and 524 feet/day. Once the hydraulic conductivity for the Pilot Plant Drainage Ditch Plume area has been determined, the results will be use to recalibrate (if necessary) the site groundwater model.

TABLE 3-1

HYDRAULIC CONDUCTIVITY FROM PUMPING TESTS IN THE GREAT MIAMI AQUIFER NEAR THE FEMP

Reference	Location	Hydraulic Conductivity (ft/day)	Hydraulic Conductivity cm/s
Dove, 1961	SOWC Wells/A	375 to 400	1.3×10^{-1} to 1.4×10^{-1}
Smith, 1962	Bolton Wellfield/B	328	1.2×10^{-1}
Klaer, 1948	Bolton Wellfield/B	120	4.2×10^{-2}
Kazmann, 1950	SOWC Wells/A	318 to 369	1.1×10^{-1}
Klaer and Lazmann, 1943	Hamilton South Wellfield/C	313 to 324	1.3×10^{-1}
Speiker and Norris, 1962	FEMP Production Well/D	267	1.1×10^{-1}
Lewis, 1968	SOWC Wells/A	334 to 404	1.2×10^{-1} to 1.4×10^{-1}
Smith, 1960	ChemDyne- Hamilton/E	214 to 412	7.5×10^{-2} to 1.5×10^{-1}
DOE, 1993	Fernald – FEMP Removal Action 3/F	413	1.5×10^{-1}
DOE, 1995	Fernald, South Field Pumping Test	523.6	1.9×10^{-1}
Smith, 1962	Ross – west bank of Great Miami River/G	534	1.9×10^{-1}
Smith, 1960	New Miami – mouth of Four Mile Creek/H	774	2.7×10^{-1}

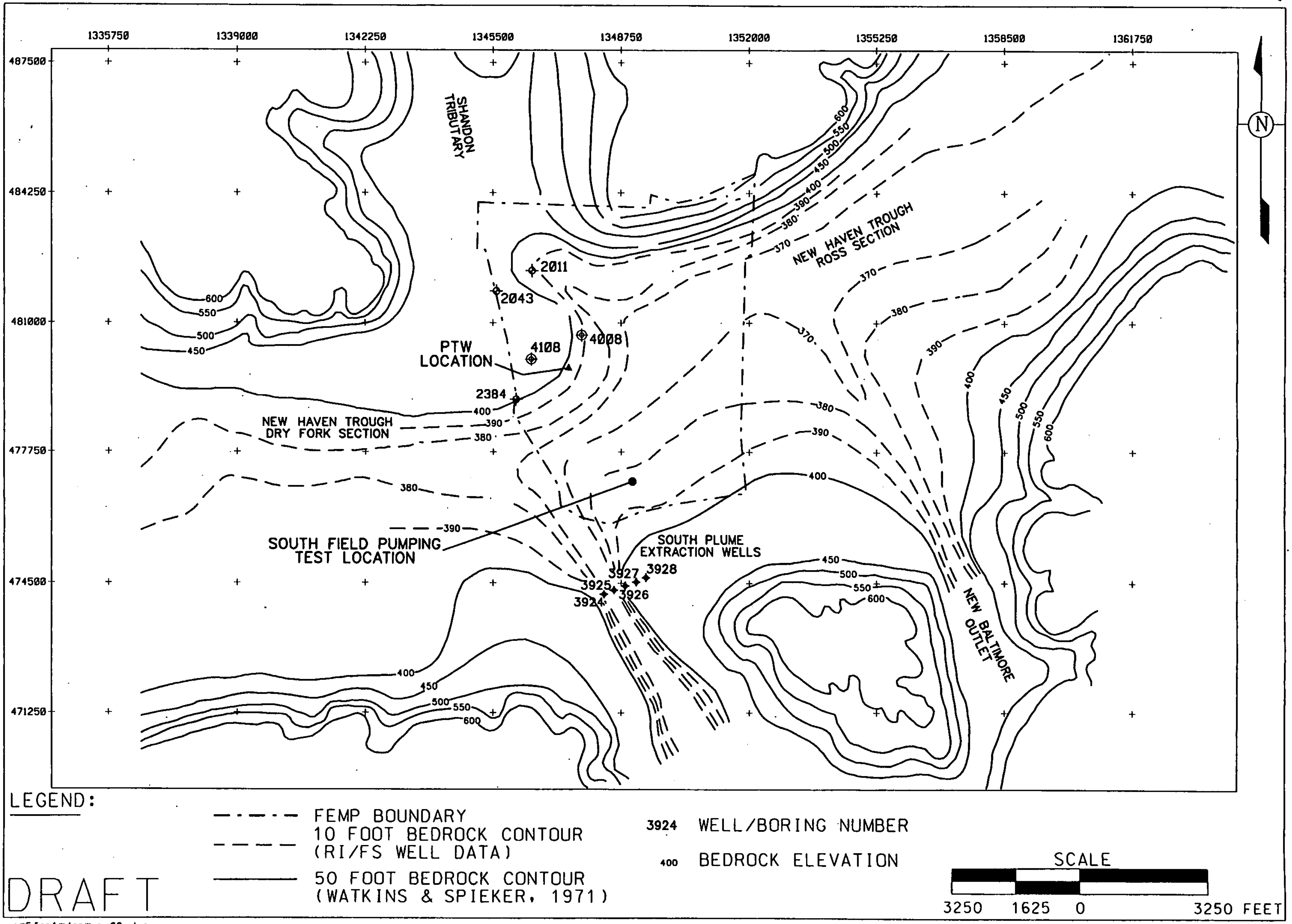

FIGURE 3-1. BEDROCK TOPOGRAPHIC SURFACE

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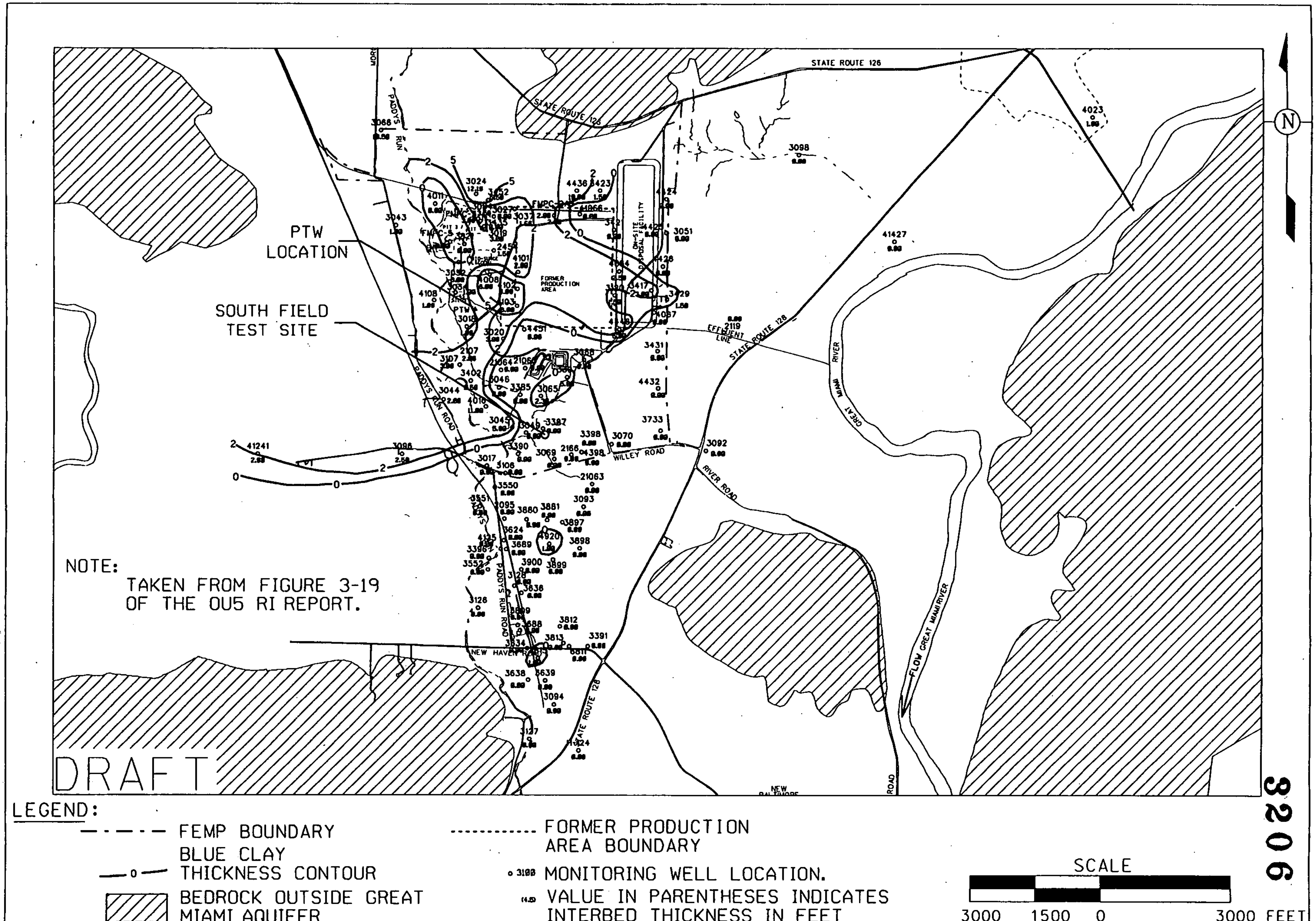

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FIGURE 3-2. CLAY INTERBED THICKNESS MAP

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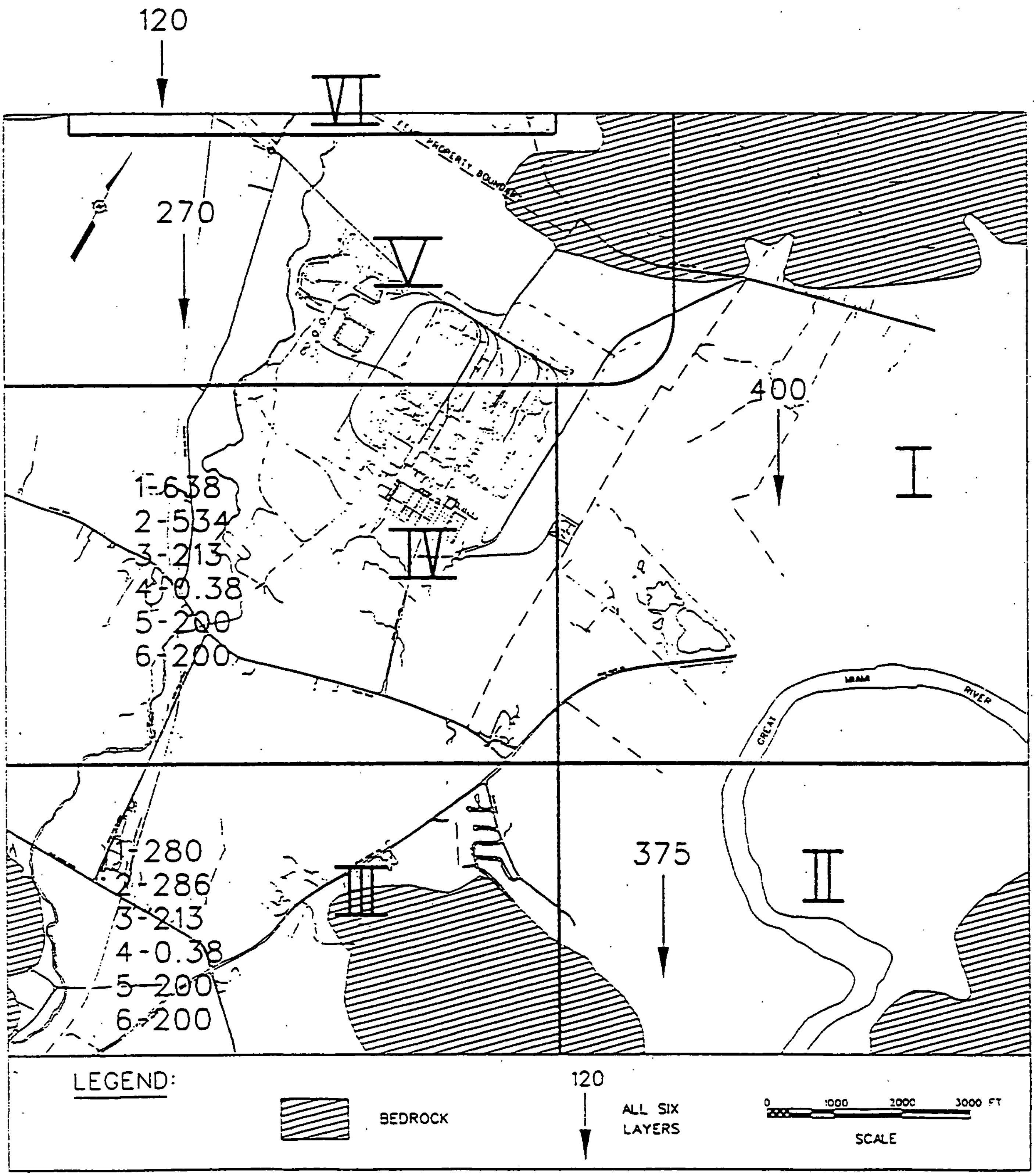

Figure 3-3 Zonation of Hydraulic Conductivity in Site Groundwater Model

4.0 DESIGN AND INSTALLATION OF THE CONTROL AND OBSERVATION WELLS

The design of the control and observation wells addresses the following criteria:

- The Control Well used for the pumping test will become Extraction Well WSA-1 following completion of the Pumping Test.
- Pumping Test Observation Wells will be used following the Pumping Test to help monitor the progress of the aquifer remediation.
- Well screen placement needs to consider remediation objectives. For instance, under ideal conditions the lower two thirds of the aquifer would be screened for a pumping test to maximize pumping capacity during the test. The uranium plume though is located at the top of the saturated aquifer, and that is the zone that the screen in the control well needs to target for remediation. In other words, performance during the pumping test will be sacrificed a little in order to design a more efficient extraction well for the aquifer remediation. But well performance during the pumping test will be more than sufficient to achieve all pumping test objectives.
- Lessons learned through the installation and operation of the South Field and South Plume Extraction Wells.

4.1 WELL PLACEMENT

The Pumping Test network of groundwater wells will consist of one pumping well, called the "Control Well" (Well 32761) and seven observation wells (Wells 32762 through 32768). Figure 4-1 is a map that shows how the control and observation wells will be located relative to each other.

Control Well 32761 is located slightly south of where proposed extraction Well WSA-1 had been identified in the Conceptual Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas (DOE 2000). The control well for the pumping test is expected to become Recovery Well WSA-1 following completion of the pumping test. This particular location was selected for the pumping test, over other proposed extraction well locations in the immediate area (e.g., WSA-8, WSA-7) because it is located just downgradient of the highest uranium concentrations found in the Pilot Plant Drainage Ditch Plume, Figure 1-1. Therefore it is considered to be the best location to begin remedial pumping.

Observation Wells 32762, 32763, 32764, 32765 and 32766 are oriented along what has been characterized as the axis of the Pilot Plant Drainage Ditch Plume. Observation Wells 32767 and 32768 are oriented in a line that extends perpendicular to what has been characterized as the axis of the main portion of the Pilot Plant Drainage Ditch Plume. This orientation should provide K_h calculations for the direction of plume migration, and perpendicular to the direction of plume migration.

4.2 SURVEYING REQUIREMENTS

A surveyor's stake with a highly visible ribbon tied around the top will be driven into the ground at each drilling location and well numbers will be written on each stake. The staked locations will be surveyed vertically and horizontally to the nearest 0.1 foot according to site procedures. Survey data for each location will be entered into the Site Environmental Data Base (SED). Consideration to existing vegetation and trees will be given as wells are being located. Re-location of some of the wells will be considered to spare existing vegetation if it is determined that the re-location will not compromise the achievement of any test objectives.

4.3 INSTALLATION AND DESIGN OF THE CONTROL WELL

In order to drill the control and observation wells, trees and vegetation will need to be removed. Trees and vegetation that are removed shall be placed in a centralized pile in the immediate adjacent area. Erosion and sediment control measures will be installed in accordance with applicable State, Federal, DOE, and FEMP requirements. The FEMP standards for erosion and sediment control follow the Ohio Department of Natural Resources, "Rainwater and Land Development" guide. The proposed sediment and erosion control measures include silt fencing and vegetation. The sediment and erosion control measures will be inspected and maintained in accordance with the site Storm Water Pollution Plan (SWPPP).

Prior to clearing, grading, and excavation activities, silt fencing will be installed along downgradient perimeters, along the contour to prevent migration of sediment eroded from exposed areas. Silt fencing will be used to intercept sheet flow, retain sediments and disperse storm water flow.

At the completion of the project, seeding of the area will be done to establish a vegetative cover. Any intermediate areas which in which activities will not resume for a period of 45 consecutive days or greater will be stabilized by applying temporary seeding within 7 days of the last excavation.

The erosion and sediment controls will be monitored by a representative of the project and Fluor Fernald weekly or within 24 hours of a precipitation event of 0.5 inches or greater. All inspections will be conducted and documented in accordance with the site SWPPP. If the inspections indicate that control measures are not adequate or effective, or the integrity of the control measure has been compromised, modifications and/or repair will be implemented immediately.

The control well will be installed in two steps.

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Step 1:

The control well will be cored using a 6-inch diameter rotosonic-drilling tool. A continuous core will be collected for the entire length of the borehole. Drilling will go no deeper than 98 feet without direction from the Technical Lead so as not to penetrate the blue clay layer. The core from the control well is being collected for two purposes:

1) To provide sieve data for the design of the most efficient well screen.
2) To allow for both qualitative and quantitative assessment of grain size variations found within the aquifer matrix.

The main objective is to get sieve data for the depth interval being targeted for the screen in the control well. A 60-foot long depth interval (38 feet bgs to 98 feet bgs) is being targeted for the placement of the well screen. This depth increment roughly correlates to the highest recorded water level elevation for the area down to the top of the clay layer that divides the aquifer into an upper and lower zone. A geologist will describe the Rotosonic core that correlates to this depth interval first. The description will include Munsell color, USCS soil classification, and textural description. The rest of the core can be described at a later date, but it is important to get this interval characterized as soon as possible so that needed sieve samples can be obtained.

The collected core will undergo a sieve analysis. All equipment used in the sieving of samples collected from the target interval (38 feet bgs to 98 feet bgs) will be decontaminated to Level 2, between samples. Sediment samples from the target interval (38 feet bgs to 98 feet bgs) will be submitted to the lab first. NOTE: No sediment samples will be removed from the core until the geologist has finished describing the interval to be sampled, and the ARWWP Hydrogeology Team Coach has had an opportunity to view the core. Sieve samples will be collected at significant changes in lithology especially targeting finer sediment sizes. Sediment size variations within the target zone need to be well defined. Core collected over the 60-foot target depth interval will be archived in wooden core boxes for future reference.

As a result of the sieving process, submitted sediment samples will be divided into size fractions based upon the size and number of sieve screens in which the sediments were passed through. Sieve samples collected from 38 feet bgs to 98 feet bgs will not be re-mixed following completion of the sieving operation. The individual size sediment fractions will be archived individually and identified with a unique sample number that indicates well identification, sample depth, and size fraction. These individual sediment fractions may be analyzed for total uranium to correlate uranium concentration with sediment size. The ARWWP Technical Lead will work with the field geologist to identify what samples will be archived in this manner.

The rotosonic boring will be temporarily abandoned to prepare for cable tool drilling as discussed below. Previous drilling experience in the GMA has shown that the formation will readily collapse back into the borehole up to the water table. At the water table coarse sand will be used to temporarily fill those portions of the borehole into which the aquifer did not collapse. It is anticipated that the cable tool rig will set up over the hole immediately after the rotosonic rig is removed from the well.

Step 2:

The temporarily abandoned rotosonic boring will be over-drilled using a 20-inch diameter cable tool-drilling rig to a depth of 98 feet bgs. Well installation shall be performed in accordance with the requirements outlined below and, unless otherwise specified, shall follow the general guidelines set forth in Appendix J of the SCQ (DOE 1998).

The control well will be constructed similar to the existing South Field Extraction Wells. It will consist of 12-inch ID, 304 stainless steel with a 304 stainless wire wrapped well screen. A five-foot long sump shall be attached to the bottom of the well screen. The actual length and depth placement of the screen will be decided upon after sieve analysis results have been obtained. The technical lead shall advise the field geologist at what depth to place the top of the well screen. A 2-inch stainless steel stilling pipe, with a 5-foot long, 0.010-inch slot screen will be installed inside of the screen. The base of the 5-foot screen will be located at the same elevation as the base of the control well screen. A 2-inch diameter stainless steel observation well with a 5-foot long, 0.010 inch slot screen, and a 2 1/2 foot long sump, will be installed in the filter pack of the well, just outside of the 12-inch well screen. The base of the observation well screen will be positioned at a depth that corresponds to the base of the 12-inch diameter screen. These two small diameter wells will be used to help assess well efficiency.

The screen in the control well will target the uranium plume identified for the area in the Conceptual Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas (DOE 2000). The length of the screen will be selected to maximize plume recovery, based on sieve analysis results.

The control well will either be completed naturally or using an artificial filter pack depending upon how fine the sediment size is in the target screen interval. If completed naturally, native material will be allowed to collapse around the screen and sump to form a natural filter pack extending to the water table. A five foot thick bentonite seal (pellets) will be installed above the natural filter pack. A backfill slurry above the bentonite seal shall extend to three feet below the ground surface. A three-foot thick concrete plug will complete the annular seal.

Based on the results of the sieve analysis, the Technical Lead may determine that an artificial sand pack is required to get an adequate yield from the well. Sand pack size and depths shall be determined based on the results of the sieve analysis. If completed using an artificial filter pack, the artificial filter pack shall extend up to a height above the well screen that is, at a minimum, equal to one-half the length of the well screen. A layer of "transition sand" will be installed above the artificial filter pack sand and will extend up to the water table. This transition sand will be a minimum of five-foot thick. This transition sand will be a finer grain sand than the filter pack sand surrounding the well screen. A five foot bentonite seal (pellets) will be installed above the transition sand. No bentonite pellets will be installed below the water table. A backfill of grout slurry above the bentonite seal shall extend to three feet below the ground surface. A three-foot thick concrete plug will complete the annular seal.

The well riser shall terminate approximately three feet above the ground surface. The well will be secured with a lockable cap. During installation of the well, the field geologist will be responsible for documenting that the correct thickness of annular fill material is being installed, and that the well screen is installed at the correct depth. Frequent measurements of the depth to the top of the annular fill need to be collected to verify the installation process. If installation work is interrupted, the field geologist will verify that the depths measured prior to the interruption are the same depths measured prior to resuming installation activities.

4.4 DEVELOPMENT OF THE CONTROL WELL

Development of the control well will begin by surging the well for approximately 24 h+ours. The surging will progress according to the stroke length of the development rig being used. The stroke length of the development rig will be called the "surge interval". Each surge interval of the well screen will be surged for one hour and the sand contained in the well, after one hour of surging, will be measured and removed prior to surging the next interval of the screen. Surging will begin slowly and gradually increase (i.e, operate the rig slowly then gradually increase power).

Following approximately 24 hours of surging, the well will be pumped for six hours for the purpose of measuring the sand content and the uranium concentration of the pumped well water. The goal of development will be to produce a well capable of delivering water with a sand content of 10 parts per million (ppm) or less. Knowledge of the uranium concentration of the pumped water is needed for treatment planning purposes. If the sand content is below 10 ppm at the conclusion of pumping, development will be considered complete. If the sand content is above 10 ppm at the end of pumping, the development shall continue until the Technical Lead determines that the well is adequately developed.

Steps for the development process are as follows:

1. Lower the surge block to the upper most surge interval of the well screen and surge the well for one hour.
2. Measure the depth to the bottom of the well. Record the depth in the comment section of the Well Development Form.
3. Using a development rig bailer, remove as much sand as possible from the well. Measure the total depth of the well to verify that the sand has been removed.
4. Lower the surge block to the next lower surge interval of the screen and surge for one hour.
5. Repeat steps 2 through 4 until you reach the bottom of the screen.
6. Raise the surge block back up to the upper most surge interval of the well screen and surge the well for one hour.
7. Repeat steps 2 through 6.
8. Continue surging in hour intervals until each well has been surged for approximately 24 hours and all of the surge intervals present in the screen have been surged for approximately the same amount of time.

4.4.1 <u>Development Pumping</u>

Upon completion of 24 hours of surging, the control well will be pumped for 6 hours for the purpose of measuring the sand content and the uranium concentration of the pumped water and the specific capacity of the well. An analytical table is provided in Table 4-1. The pumping will be performed as follows:

1. Measure the total depth and the static water level of the well and record the information on the Field Activity Log.
2. Pump the well for two hours at a rate that is approximately 1/3 of the design capacity as specified by the Technical Lead. Measure the water level of the pumping well approximately every 20 minutes.
3. Conduct a sand content test after 15 minutes, 30 minutes, 60 minutes, 90 minutes, and 120 minutes of pumping. Steps for conducting a sand content test are provided below. After two hours of pumping, collect a sample of pumped water for uranium analysis at the onsite lab. Request a 24-hour turn-a-round.
4. After two hours of pumping, increase the pumping rate to 2/3 of the pump design capacity as specified by the field geologist. Pump the well for two hours and repeat the measurements and sampling described in 2 and 3 above.

5. Increase the pumping rate to the design capacity of the pump as specified by the field geologist. Pump the well at this rate for two hours and repeat the measurements and sampling in Steps 2 and 3 above.

6. After approximately 6 hours of pumping, stop the pumping.

7. Measure the recovery rate of the well by taking water level measurements every 30 seconds until the water level is to within one foot of the static water level recorded before the start of pumping 6 hours earlier.

NOTE: A total of three uranium samples will be collected.

4.4.2 Sand Content Testing

Sand content will be measured by passing a sample of the pumped well water through a centrifugal sand sampler. The centrifugal sand sampler will be installed in the discharge line used for development, just slightly down gradient of the well head. Operation of the sand content sampler is described below:

1. Install the centrifugal sand content tester in the discharge line. The inlet should be located on the horizontal centerline of the discharge pipe and as close to the discharge head as possible.

2. Open the inlet valve to the tester wide open. Adjust the outlet valve to 1/2 gpm. (This will fill 1 quart in 30 seconds or 1 gallon in 2 minutes).

3. Close the inlet valve, remove, clean, and replace the glass tube.

4. When ready to start the sand content test, record the start time and open the inlet valve wide open.

5. After 5 minutes, record the amount of accumulated sand in the glass tube. Calculate the sand rate by dividing the amount of accumulated sand by 5 minutes (the amount of time to accumulate the sand).

6. Periodically check the flow rate through the tester during each run. If the flow rate is not 1/2 gpm, repeat the test.

7. Calculate the rate of sand production per unit of water according to the following calculation:

$$[\text{Sand rate (ml/min)}]/$$

$$[0.5 \text{ gpm X } 231 \text{ In}^3\text{/gallon X } 16.387 \text{ ml/in}^3]*1E6=\text{ppm}$$

4.5 INSTALLATION AND DESIGN OF THE OBSERVATION WELLS

Seven observation wells (Wells 32762, 32763, 32764, 32765, 32766, 32767, and 32768) will be installed for the pumping test using a Rotosonic Drilling Rig. Continuous core will be collected from each drilling location. Six of the wells will be installed above the clay layer (Wells 32762, 32763, 32764, 32766, 32767, and 32768). These six wells will be installed by drilling six-inch diameter boreholes to a depth of 80 feet bgs. This depth roughly correlates to the depth being targeted for the midpoint of the screen in the Control Well. The seventh Observation Well (Well 32765) will be installed by drilling a six-inch diameter borehole to a depth of approximately 120 feet bgs. This depth will allow the well to be completed such that the top of the screen will be positioned approximately five feet below the base of the clay layer that divides the aquifer into an upper and lower region. This clay layer acts as an aquitard to the movement of fluids. Monitoring water levels below the clay layer will provide data to determine if and how pumping in the upper region effects the lower region.

The Rotosonic core will be described by a geologist (e.g. Munsell color, USCS coil classification, textural description, and depositional features). A geologist will also record any observable depositional features such fining upward and downward sequences and complete a lithologic log. It is not necessary to delay drilling activities in order to describe the core and collect sieve samples, but work should be completed as quickly as possible following the drilling. Sieve samples will be used to allow for both a qualitative and quantitative assessment of rain size variation found within the aquifer matrix. The aquifer sediments will be sieved as directed by the field geologist

The observation wells will be constructed of two-inch diameter PVC. They will each have a five-foot long, 10-slot screen with a 2 1/2 foot long sump attached below the screen. This screen slot size is the standard and proven groundwater monitoring well slot size that has been in use at Fernald since the RI/FS. Five feet of Rotosonic core (the interval that corresponds to the zone that the well screen is completed in) will be archive in core boxes for future reference.

The observation wells will be completed using a filter pack. The filter pack sand will extend to a height of approximately 5 feet above the top of the well screen in all of the observation wells except Well 32765. This well will be completed below the blue clay. The natural formation will then be allowed to collapse in on top of the filter pack sand up to the water table. A five foot thick layer of bentonite pellets will be installed, followed by a grout slurry which will extend to three feet below the ground surface. A three-foot thick concrete plug will complete the annular seal.

In observation well 32765, the filter pack will extend 2.5 feet above the top of the screen. (This is subject to change pending on drilling results, and the recorded thickness of the blue clay through which the boring was drilled through). Bentonite pellets will be installed above the filter pack to as to provide a good seal across the blue clay layer. The bentonite weal will extend to a height of 5 feet above the blue clay. The natural formation will be allowed t collapse back into the borehole up to the water table, where another 5-foot bentonite plug will be installed. Above this second bentonite seal, a grout slurry shall be installed to extend to three feet below he ground surface A three foot thick concert plug will complete the annular seal.

4.6 DEVELOPMENT OF THE OBSERVATION WELLS

The observation wells will be developed following the same general methodology that has been used to develop groundwater-monitoring wells. The wells will be pumped while water quality parameters (turbidity, pH, specific conductance, and temperature) are measured. Pumping will continue until the turbidity of the water is clear and has stabilized at 5 nephelometric turbidity units (NTUs) or less.

4.7 MANAGEMENT AND DISPOSITION OF DRILL CUTTINGS

Drill cuttings generated by the cable-tool-drilling rig during the installation of the control well will be handled in accordance with the Project Waste Identification Document. Drill cuttings generated during Rotosonic drilling will be collected in core bags.

4.8 EQUIPMENT DECONTAMINATION

Drilling and sampling equipment shall be decontaminated to Level 1, using a pressure washer to remove visible materials, prior to transport to the drilling location, if the equipment is being moved from a Controlled Area. Decontamination of the drilling equipment will not be necessary if the equipment has been used previously in an uncontrolled area. Upon completion of drilling and sampling activities, decontamination of tools and equipment shall be performed to fulfill the Level 1 specifications of the site SCQ.

4.9 MANAGEMENT OF PUMPED GROUNDWATER DURING DEVELOPMENT

During development of the control well approximately 216,000 gallons of water will be pumped (two hours at 400, 600, and 800 gpm pumping rates). This water has the potential for having a uranium concentration of several hundred micro-grams per milliliter or parts per billion (ppb). This water will need to be properly handled and disposed of. Pumped water will be sent to the Storm Water Retention Basin (SWRB) headworks of the AWWT Phase I system through temporary hoses.

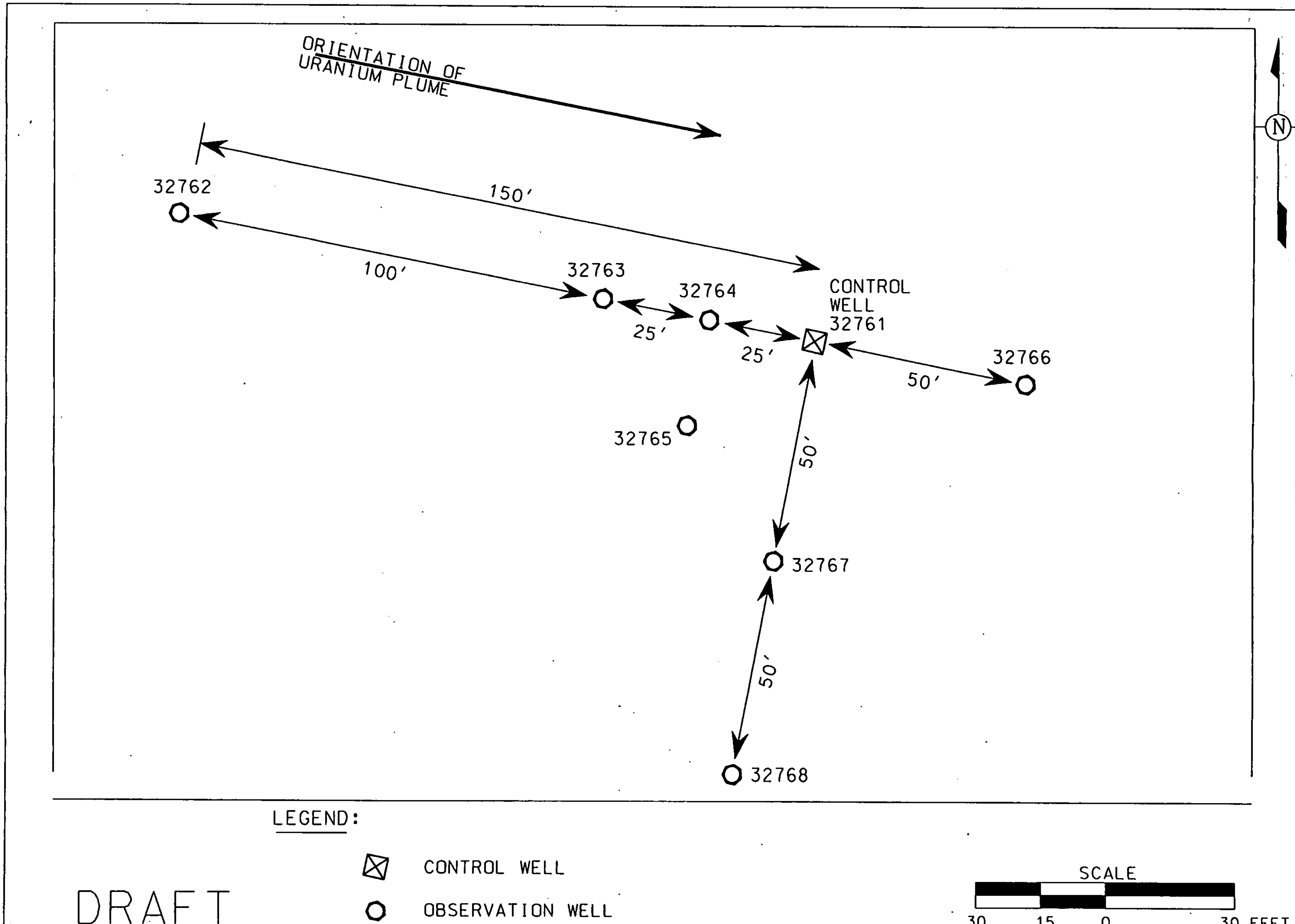
4.10 INSTALLATION OF A TEMPORARY DIRECT PUSH WELL FOR MONITORING WATER LEVELS AT THE CONFLUENCE OF THE PILOT PLANT DRAINAGE DITCH AND PADDYS RUN

A temporary direct push water level monitoring well will be installed near the confluence of the Pilot Drainage Ditch and Paddys run. Should heavy precipitation occur during the pumping test, this area of the aquifer should be the closest to the recharge point, and therefore respond first to recharge conditions. By monitoring water levels in the aquifer at this location during the pumping test, the effects of any possible recharge events during the pumping test can be determined and factored into hydraulic conductivity calculations. The ARWWP Technical Lead will be responsible for locating where the temporary well will be installed.

TABLE 4-1

ANALYTICAL PROGRAM REQUIRMENTS

Constituent	Sample Type	ASL	Holding Time	Preservation	Container
Total Uranium	Grab	B	6 months or 5x half-life, whichever is less	HNO_3 to pH < 2	Plastic or glass

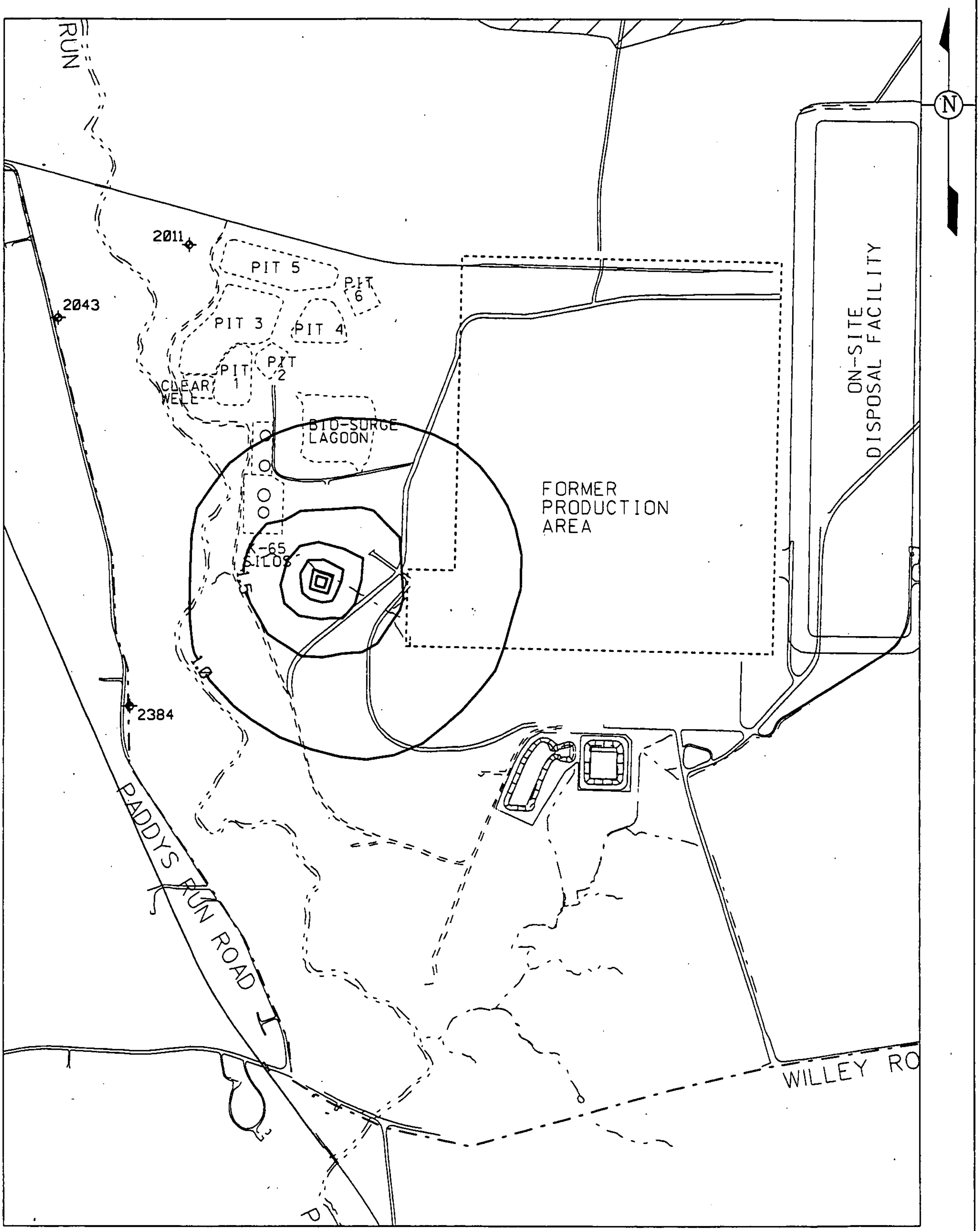


DRAFT

v:*5crw2*dgn*ken_b*ken00061.dgn
01-AUG-2000

FIGURE 4-1. PUMPING TEST NETWORK

v:#5crw2#dgn#ken_b#ken00062.dgn



STATE PLANAR COORDINATE SYSTEM 1983

01-AUG-2000

LEGEND:

—·—·— FEMP BOUNDARY

SCALE

1000 500 0 1000 FEET

DRAFT

FIGURE 4-2. PREDICTED DRAWDOWN WITH CONTROL WELL PUMPING AT 800gpm

5.0 PUMPING TEST ACTIVITIES

The idea behind a pumping test is that as water is pumped from a well, measurements of discharge and drawdown in the pumping well, and measurements of drawdown in nearby observation wells are collected. These measurements are then substituted into an appropriate well-flow equation in order to calculate various hydraulic characteristics (Kruseman and deRidder 1989).

Pumping test activities will include the following:

- Pre-Test Monitoring: Water levels in the observation wells will be monitored for a minimum of 2 weeks prior to the step test. Water levels in the surrounding background wells will be monitored for a minimum of one month prior to the step test.
- Step Test: The step test will be approximately 400 minutes long. Four pumping rates are planned (200 gpm, 400 gpm, 600 gpm, and 800 gpm).
- Recovery Monitoring: The aquifer will be allowed to recover prior to initiating the constant rate test; a minimum of 1 day. Water levels will be used to determine when recovery has been achieved.
- Constant Rate Test: The constant rate test will be conducted for seven days.(10,000 minutes). The pumping rate will be determined from the results of the step test.
- Recovery Monitoring: Water levels in the observation wells and surrounding monitoring wells will be monitored until it has been documented that recovery has been achieved.

5.1 TEST EQUIPMENT

The following equipment will be required to conduct the testing program:

For the pumping system

- A submersible or vertical shaft turbine pump that can be accommodated by the control well with a check valve to prevent water from siphoning back into the well. The pump must be capable of operating accurately between 200 and 800 gpm against the static and friction head necessary to pump the water to the Storm Water Retention Basin (SWRB) via the Storm Sewer System.
- A power source sufficient to operate the pump (including fuel), and capable of continuous operation as long as 8 days, with a backup. If an internal-combustion engine is used, it shall be equipped with a tachometer.
- The piping and necessary fittings to go from the pump to the SWRB via the Storm Sewer System.
- A power source for ancillary field equipment (including lighting system for night work).
- A primary and backup gate valve to control discharge from the control well.
- A digital flow meter and totalizer to measure flow in gpm and total discharge in gallons of water.

- An analog flow meter and totalizer to measure flow in gpm and total discharge in gallons of water.

- A sampling port on the flow line for the collection of groundwater samples.

- A lighting system for night work.

To measure flow rates

- A stop watch.

- A field notebook and flow rate recording forms.

To measure GMA water levels

- Thirteen transducers are needed. Nine transducers will be used to monitor the immediate pumping test area (one in and one outside of the screen in the control well and one in each of the seven observation wells). Three of the transducers will be used to monitor background wells, and one may be used to monitor a temporary direct push well at the confluence of Paddys Run and the Pilot Plant Drainage Ditch.

- Two eight-channel data logger system (one for backup) to record water level readings from the two transducers installed in the control well and the transducers installed in six of the observation wells (32762, 32763, 32764, 32767, 32768, and 32766).

- Seven one channel data logger systems (two for backup) to record water level readings in Observation Well 32765, the temporary direct push well installed at the confluence of Paddys Run (if a transducer is used) and the Pilot Plant Drainage Ditch, and the three background water level monitoring Wells (2011, 2384, and 2043).

- Two electric water level (M-Scopes) measuring tapes.

- Deionized water and disposable towels for decontaminating M-Scopes.

- Field activity logs.

To collect water samples

- Sample bottles.

- Turbidity meters.

- Specific conductance, pH, temperature, and dissolved oxygen probes and meters.

Miscellaneous

- 2 flashlights.

- Indelible pens and/or pencils.

- Health and safety equipment and clothing.

- Portable lap top computer, equipped with software needed to communicate with and download data logger systems.
- Portable phones.
- Extra batteries for water level probes (M-Scopes) and flashlights.

5.2 EQUIPMENT SHAKEDOWN

To minimize unforeseen problems, all equipment will be subjected to a performance shakedown 2 days before being used. Power supplies, the pump, flow lines and discharge collection systems, valves, gauges, meters, lighting, recorders, data loggers, and any other equipment subject to mechanical, structural, and/or electrical failure will be inspected and field tested before start of the pumping test. The shakedown will include a practice run that replicates the first step of the step drawdown test and a demonstration of the 800 gpm-pumping rate. The drilling contractor will maintain records of the shakedown.

5.3 COLLECTION OF DATA

The following is a listing of the data collection activities that will be conducted during the pumping test. Further discussion for the collection of the data follows in subsequent sections.

- Measurement of water level in wells that are out of the region of influence of the pumping well. These wells will be identified in this work plan as the "Background Water Level Wells". The data from these wells will be used to determine how the water level in the aquifer was trending prior to and following the test.
- Hourly measurements of precipitation, atmospheric pressure and air temperature.
- Measurement of water levels in a temporary well installed at the confluence of Paddys Run and the Pilot Plant Drainage Ditch.
- Synchronized measurement of drawdown in the control well and six of the observation wells.
- Measurement of discharge from the control well.
- Discharge rate for the control well as measured using a digital flow meter with a backup analog flow meter.
- Uranium concentration of the pumped groundwater.

5.3.1 Background Water Level Measurements

Because the Pumping Test Location is located downgradient of both the Shandon Tributary and the Dry Fork Section of the New Haven Trough (See Figure 3-1) background water levels will be monitored in both features.

The groundwater model was used to simulate a pumping rate of 800 gpm from the control well. Figure 4-2 is a map showing the predicted water level drawdown with the control well pumping at 800 gpm. Three groundwater-monitoring wells have been selected, Monitoring Wells 2384, 2011, and 2043, Figure 4-2. These wells were selected because the model predicts that they fall outside of the one-foot water level drawdwon predicted by the pumping of the control well at a rate of 800 gpm. It is anticipated that during the constant rate test that the control well will not be pumped at this high of a rate. Figure 3-1 shows the location of the wells relative to the Pumping Test Location, the Shandon Tributary and the Dry Fork Section of the New Haven Trough. The objective for monitoring these three locations is to document how the water table in the aquifer, surrounding the pumping test location but out of the influence of the pumping, is fluctuating during the pumping test.

It is anticipated that the pumping test will be conducted in the early fall. During this time water levels in the aquifer are usually declining. This natural decline in water level, determined through the monitoring of water levels in these background wells, will be used to correct drawdown measurements collected in the observation wells during the pumping test. This correction is needed so that only drawdown due to the pumping is used to calculate hydraulic properties.

Background water level monitoring will begin at least two weeks before the step test begins. Hourly measurements will be collected using down-hole pressure transducers and data logger instrumentation. Measurements will be recorded in feet above mean sea level. If possible, all three data loggers will be programmed to begin collecting hourly measurements at the same time. The hourly measurements will continue throughout the testing program and following the testing program until it can be documented that the aquifer has recovered.

5.3.2 Precipitation, Atmospheric Pressure and Temperature Measurements

All of these measurements are currently being collected at the Fernald Site Weather Tower. No additional effort will be required for the pumping test.

5.3.3 Measurement of Water Levels in a Temporary Monitoring Well installed at the confluence of Paddys Run and the Pilot Plant Drainage Ditch.

A temporary direct-push monitoring well will be installed at the confluence of Paddys Run and the Pilot Plant Drainage ditch for the purpose of monitoring water levels during the pumping test. If recharge does occur through either feature during the pumping test, a response should first be seen at this location. Monitoring at this location will provide good information concerning whether or not drawdown measurements collected during the pumping test need to be corrected for recharge events that occurred during the constant rate test. If the diameter is large enough, a transducer and datalogger system will be installed and programmed o record hourly water level measurements. If the diameter is not large enough to provide for the installation of a transducer, twice daily measurements (one every 12 hours) will be recorded during the pumping test using an M-scope. During periods of precipitation during the step of constant rate test, hourly measurements will be recorded using an M-scope. The twice-daily measurements will begin at least two weeks prior to the step test, and continue after the constant rate test has been completed until it has been documented that the aquifer has recovered.

5.3.4 Drawdown Measurements in the Control Well and Observation Wells

Measurements will be collected using down-hole pressure transducers and automatic datalogger instrumentation. An 8-channel data logger will be used to synchronize and collect drawdown from the control well and six of the observation wells (32762, 32763, 32764, 32766, 32767, and 32768). Beginning two weeks before the step test hourly readings will be collected from all of the observation wells. During the testing program, the "testing mode" function of the instrumentation will be used to collect water level data on a logarithmic scale. This is further discussed in the section that discusses the step test and constant rate test. Following completion of the step test and constant rate test, the data logger will be programmed to go into the recovery mode. The recovery mode will be programmed such that it will end with a measurement being collected every 100 minutes. Measurements will continue to be collected measurements every 100 minutes until it has been documented that the aquifer has recovered.

A single pressure transducer and data logger combination will be used to monitor drawdown in Observation Well 32765. Readings will be recorded in units of feet above mean sea level (amsl). Observation well 32765 will be completed beneath the clay layer that separates the aquifer into two zones. The purpose of monitoring beneath the clay is to document whether or not pumping from above the clay, in the upper aquifer unit, has any effect on water levels below the clay in the lower unit. Readings will be collected hourly beginning one two week before the start of the step test. Readings will continue on an hourly schedule during the testing program, and following the constant rate test until it has been documented that the aquifer has recovered.

5.3.5 Discharge Measurements from the Control Well

During the step test, discharge measurements will be collected at the start of each step, and every 10 minutes during each step. During the constant rate test, discharge measurements will be made every 10 minutes for the first 100 minutes, then every 100 minutes until the end of the test.

5.3.6 Uranium Concentration Measurements of the Pumped Groundwater

A sample of the pumped groundwater will be collected for the analysis of total uranium upon the start of the step test, and at the completion of each step used in the step test. An analytical table is provided in Table 4-1. During the constant rate test, a sample of the pumped groundwater will be collected at the start of the test (within the first hour of pumping) and every day at approximately the same time of the day that the first sample was collected. The total volume pumped at the time of sample collection will also be recorded. A groundwater sample will also be collected, for the analysis of uranium, just prior to turning off the pump at the end of the constant rate test.

5.3.7 Management of Pumped Groundwater

If the pumping test is conducted as outlined above, approximately 200,000 gallons of water will be pumped during the step test, and approximately six million gallons of water will be pumped during the constant rate test (assuming 600 gpm for 10,000 minutes). Pumped water will be directed to the existing Storm Sewer System for gravity flow to the SWRB headworks of the AWWT Phase I system through temporary hoses.

6.0 DATA MANAGEMENT, ANALYSIS AND REPORTING

Data collected during the investigation will be properly managed during and following completion of the field activities. Data and field documentation generated during the investigation shall be checked to ensure compliance with the site procedures and the SCQ.

As specified in the SCQ, sampling teams shall describe daily activities on the Field Activity Log sufficient for the sampling team to reconstruct a particular situation without reliance on memory. The field geologist shall complete lithologic logs for each boring as specified in Section J.4.1.2 of the SCQ. Sample collection logs shall be completed according to instructions specified in Appendix B of the SCQ. Field documentation shall be checked for completeness and accuracy.

Uranium concentration data shall be entered into the FEMP Site-Wide Environmental Database. Manual, double-keyed data entry shall be performed and the entered data shall be compared to the original data sheets; corrections shall be initiated and dated, and made as necessary. Hard-copy documents will be kept in permanent storage in the project files.

Data collected from the pumping test will be used to calculate hydraulic conductivity and anisotropy. All water-level data and flow data will be expressed in units of feet and gallons per minute. Drawdown will be corrected for natural recharge, storm-induced recharge, and atmospheric pressure before selection and use of a solution method. The effect that well bore storage has on early time data will also be assessed.

Theoretical solutions to well-flow problems are usually not unique (Kruseman & de Ridder 1989). Several different solutions may need to be looked at depending upon the results of the test. The rationale used to support the selection of an analytical solution will be documented along with any reported results.

All measurement data collected and used for the purpose of determining aquifer parameters will be tabulated and presented in a pumping test report. Graphs and tables of data will be used as appropriate to aid in the data reduction process. Data logger printouts and original field documentation will be maintained in project files according to site procedures. The pumping test report will contain background information on the testing activities, a description of the pumping test, and the analysis of the data, including the calculated aquifer parameters.

7.0 HEALTH AND SAFETY

Fluor Fernald and subcontractor personnel shall conform to precautionary surveys performed by the personnel representing the Utility Engineer, Industrial Hygiene, and Radiological Control. Concurrence to applicable safety permits (indicted by the signature o the personnel assigned to his project) is expected from all project personnel in the performance of their assigned duties.

The Fluor field supervisor will ensure that all Fluor personnel and subcontractors performing project-related activities have read or been briefed to the Project Health and Safety Matrix (PHSM), and the applicable surveys that protect worker safety and health. Signing the PHSM is an acknowledgment of reading and understanding it. It is important for all personnel involved in the drilling and sampling activities associated with this pumping test. A copy of applicable safety permits/surveys issued for worker safety shall be available for reference/review at each sample location, and at the completion of the project, the completed forms shall be submitted for incorporation into the project files.

8.0 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

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Well installation and development work follows Quality Assurance/Quality Control (QA/QC) protocol.

8.1 PROJECT REQUIREMENTS FOR SURVEILLANCE

Self-assessment of work processes and operations shall be undertaken to assure quality of performance. Self-assessments may be performed by the Key Personnel identified in Section 2.0 of this PSP, and shall encompass technical and procedure requirements. Such self-assessment may be conducted at any point in the project.

Independent assessments shall be performed by the Fluor Fernald QA organization by conducting surveillances. At a minimum, one surveillance shall be conducted, and will consist of monitoring/observing ongoing project activity and work areas to verify conformance to specified requirements. Surveillance shall be planned and documented in accordance with Section 12.3 of the SCQ.

8.2 CHANGES TO THE PROJECT SPECIFIC PLAN

Prior to the implementation of any change, the Project Lead, ARWWP Hydrogeology Section Team Coach and/or Technical Lead shall be informed of the proposed change. Once approval has been obtained from the Project Manager and/or Technical Lead and QA representative for a change to the PSP, the field change may be implemented. Variances shall be processed, per Section 15.3 of the SCQ.

9.0 REFERENCES

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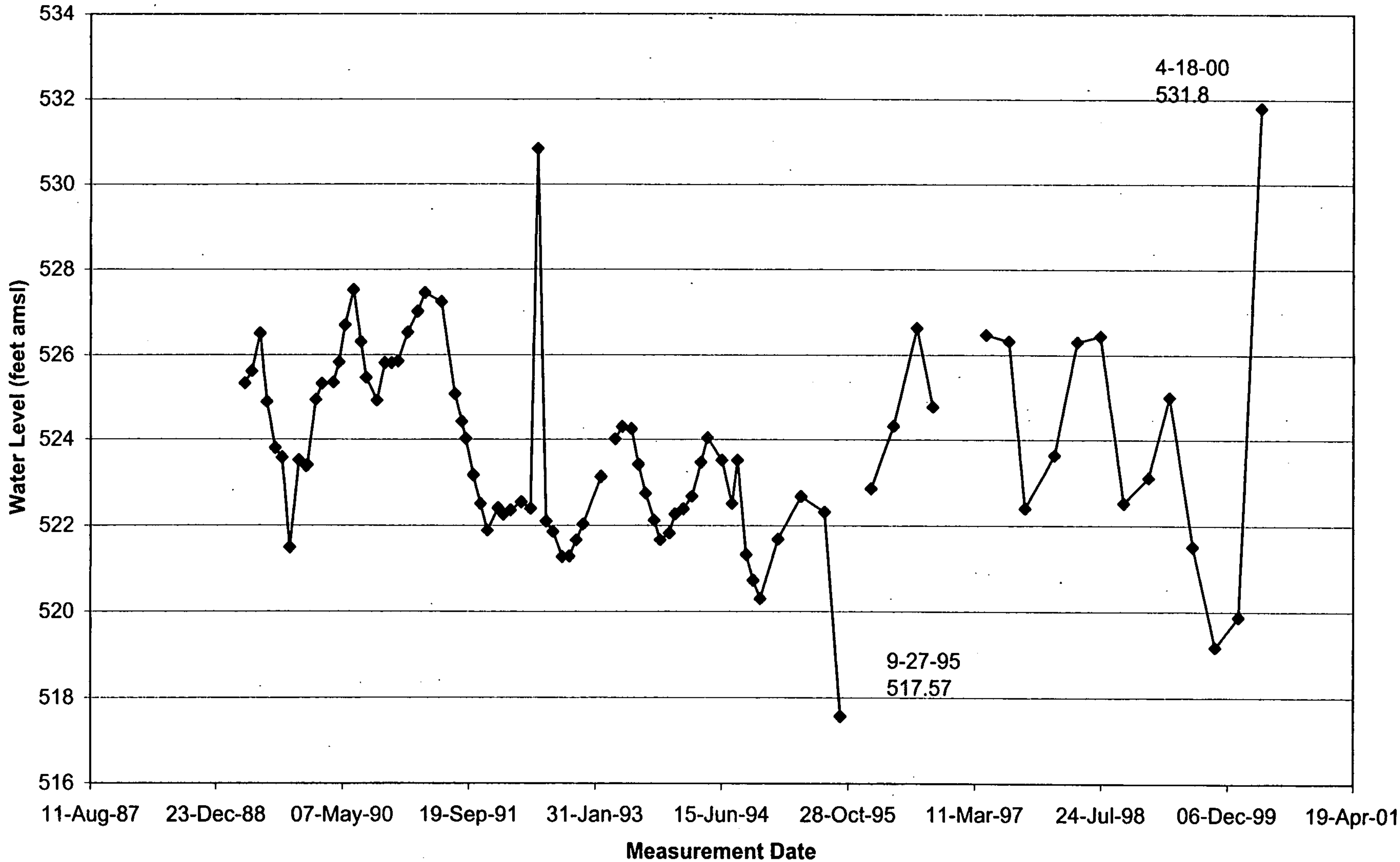
APPENDIX A

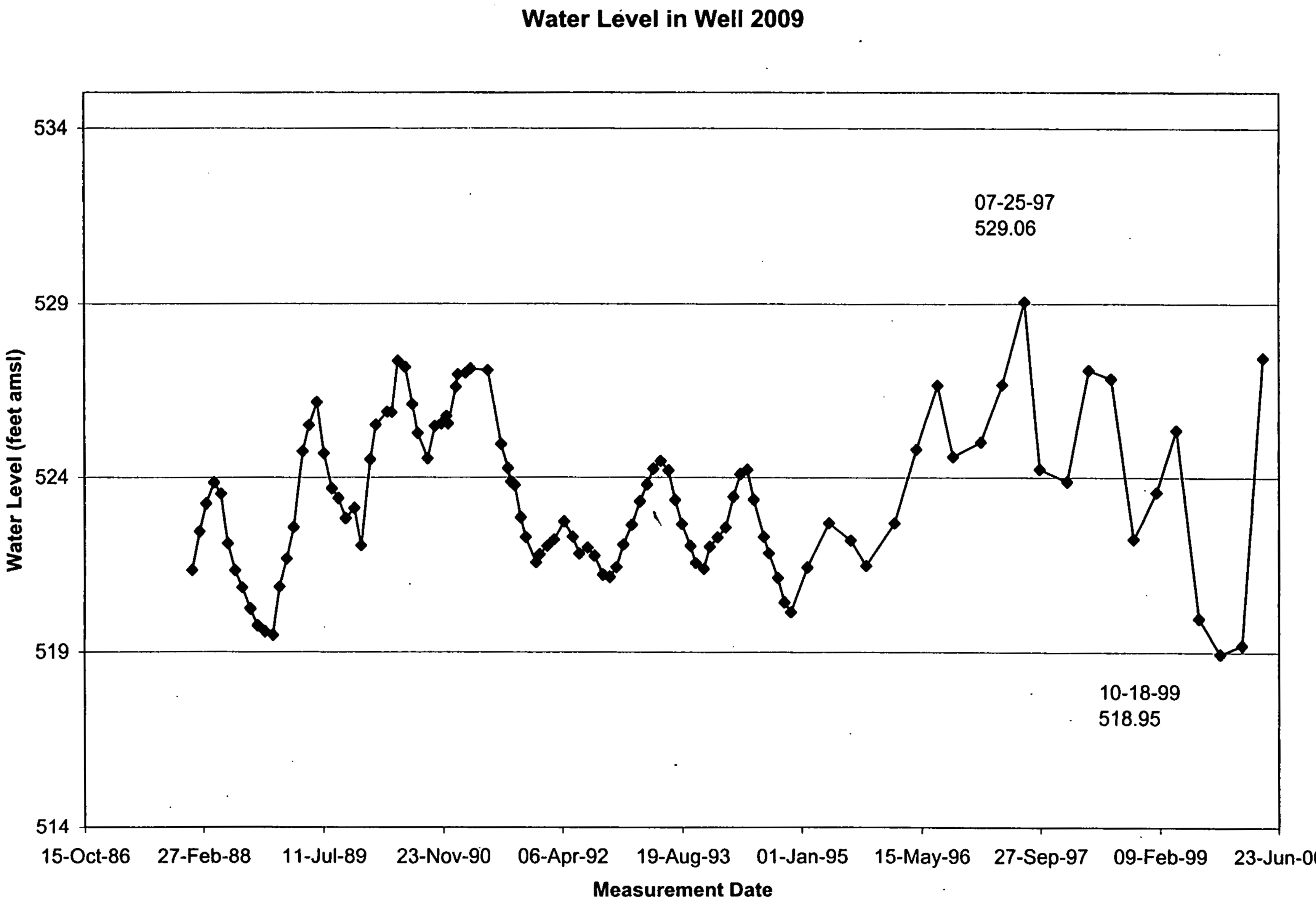
HYDROGRAPHS FOR WELLS 2108, 2009, 2042, AND 2020

Water Level in Well 2108

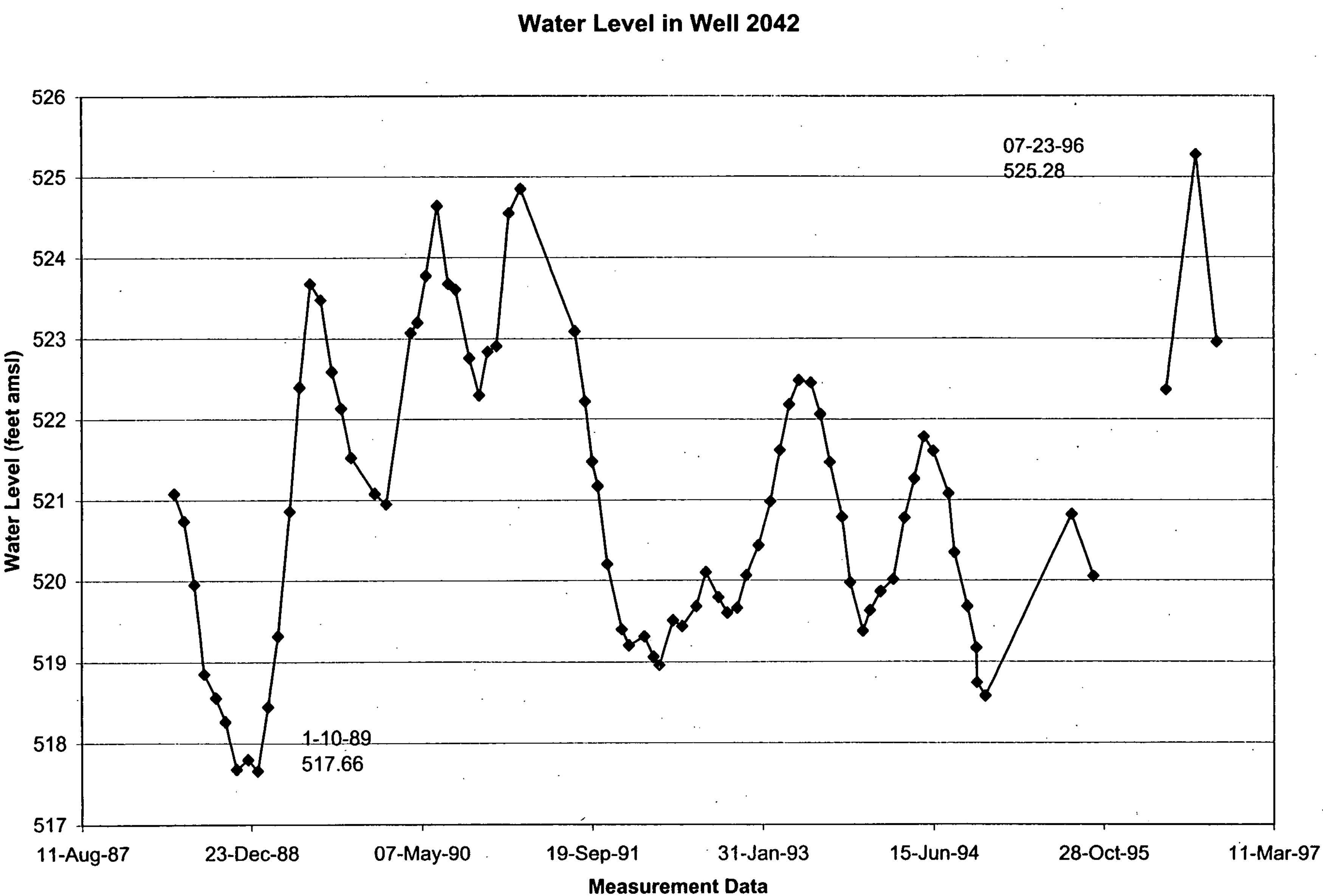


000041

3206


Water Level in Well 2009
Water Level (feet amsl)
534
529
524
519
514
07-25-97
529.06
10-18-99
518.95
15-Oct-86
27-Feb-88
11-Jul-89
23-Nov-90
06-Apr-92
19-Aug-93
01-Jan-95
15-May-96
27-Sep-97
09-Feb-99
23-Jun-00
Measurement Date

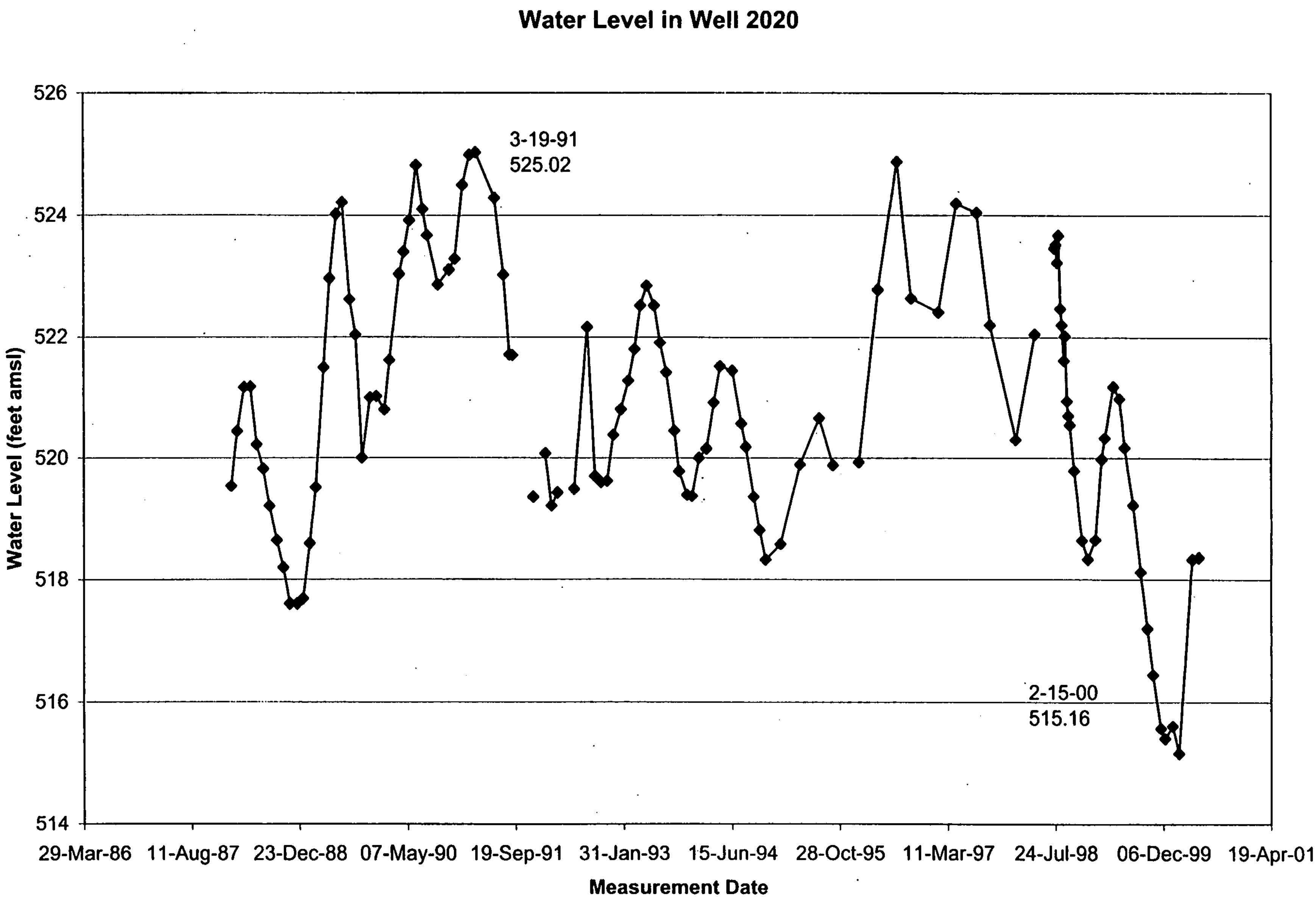
000042



Water Level in Well 2042
07-23-96
525.28
1-10-89
517.66
Water Level (feet amsl)
526
525
524
523
522
521
520
519
518
517
11-Aug-87
23-Dec-88
07-May-90
19-Sep-91
31-Jan-93
15-Jun-94
28-Oct-95
11-Mar-97
Measurement Data

000043

3206


Water Level in Well 2020
Water Level (feet amsl)
526
524
522
520
518
516
514
3-19-91
525.02
2-15-00
515.16
29-Mar-86
11-Aug-87
23-Dec-88
07-May-90
19-Sep-91
31-Jan-93
15-Jun-94
28-Oct-95
11-Mar-97
24-Jul-98
06-Dec-99
19-Apr-01
Measurement Date